

1338-21

1-15-43



Pennsylvania Railroad Station, New York City. A batten type .021" Monel roof covers an area of 300,000 square feet, and was installed when the building was built in 1910. In 1936, 82,000 square feet of skylights originally installed in another metal were replaced with Monel.



The New York Public Library, 151,000 square feet of Monel .025" in thickness were used for a batten-type roof, eaves, gutters, and leaders. The Monel roof was installed in 1936, and replaced another metal with which the building was originally roofed in 1910.



Metropolitan Museum of Art, New York City, 120,000 square feet of .021" Monel sheet were used for standing seam roofs, and .025" Monel for skylights on two wings of the building in 1936.



Brooklyn Museum of Arts and Sciences. Approximately 12,000 square feet of .021" Monel sheet were used for standing seam roof, skylight and ventilators on wing D. This roof was also installed in 1936.

(Photos by Gendreau—New York)

# MONEL FOR PERMANENT ROOFS

FRANKLIN DISTRICT  
PHILADELPHIA



# MONEL ROOFING — Basic

## RANGE OF ADAPTABILITY

Properties and working characteristics of Monel Sheet make the material suitable as a sheet metal roofing for any type or size of building. But it is particularly adapted for roofing installations where permanence and low maintenance expense are specification requirements more essential than low initial cost. Design and installation of Monel Roofing does not generally involve deviation from practices recognized as standard for other types of sheet metal roofing. The few exceptions are noted below (see Installation).

Monel Roofing sheet is made from an alloy containing approximately two-thirds nickel and one-third copper, specially annealed, pickled and rolled to adapt it to the bending, forming, seaming and soldering operations required in laying metal roofings. In sheets of standard roofing gauges Monel Roofing can be employed to solve any sheet metal roofing problem, including installation of skylight caps, skylight and penthouse siding and roof flashings, gutters, cornices and downspouts.

## CHARACTERISTICS

Table I presents a physical property comparison between Monel, copper, terne plate and lead. Figures given are averaged from tests by laboratories recognized as unbiased by the metals industry and are generally accepted as representative for sheet metal roofing gauges.

**Physical Properties** of Monel Roofing render it exceptionally resistant to damages common to sheet metal roofing. It is about one-third stronger than steel, more than twice as strong as copper roofing, much harder than copper and tougher than either of these two materials. Its rigidity is greater than comparable gauges of copper and is approximately the same as steel. Hardness (indicated by Shore test) is high and the coefficient of linear expansion is lower than other commonly used roofing metals and approximately equal to that of steel.

In practical terms, figures in Table I indicate that Monel Roofing will tend to withstand deformation during installation and will not be readily damaged from impact, abrasion or flexure after installation. The high comparative fatigue limit of Monel Roofing greatly reduces the possibility of failure by fatigue cracking known to the roofing trade as "wiggleracks."

Galvanic corrosion is not generally a source of serious damage to sheet metal roofs.

Monel Roofing can be installed in contact with copper, brass, bronze or lead without danger of corrosion from galvanic action. However, when Monel is used in contact with iron, steel, zinc or aluminum, galvanic action may take place, particularly in areas of high relative humidities or in localities

TABLE I—Physical Property Comparison

Test	Monel	Copper	Terne Plate	Lead
Tensile Strength	70,000 to 85,000	36,000	45,000 to 50,000	1,600 to 2,400
Modulus of Elasticity	26,000,000	18,300,000	27,000,000	1,000,000
Coeff. Linear Exp. per °F	.00000778	.0000095	.00000675	.00001505
Endurance (Fatigue) Limit lb. per sq. in.	35,000	10,000	24,000	2
Hardness (Shore)	17 to 23	6 to 7	26 to 30	2
Toughness (Izod)	over 120		58	

where corrosive atmospheres are prevalent. Monel is not damaged under these conditions, but the other metals may be affected unless separated from direct contact with Monel by saturated roofing felt, a coating of tar or asphalt, or other similar means.

Monel Roofing is a fireproof material. The metal will anneal at temperatures from 1650 to 1900°F. But no physical deformation or change of the metal's internal structure takes place at lower temperatures. Physical characteristics of Monel sheets are not seriously affected by temperatures under 2100°F.

**Corrosion Resistance.** The ability of Monel to resist attack by acids, alkalis and salt solutions is an inherent characteristic of Monel Roofing. It is highly resistant to the corrosive atmospheres of urban, industrial and sea coast areas. Resistance of Monel to atmospheric corrosion is evidenced by roofing installations up to 25 years of age in congested urban and industrial areas. For example, laboratory measurements on Monel sheets taken from the roof of the Pennsylvania Station in New York City indicate that, theoretically, 300 years would be required to destroy the sheet.

**Color** of Monel Roofing when first installed is a soft gray, somewhat similar to brushed platinum. On exposure in sunlight the color of Monel gradually becomes a neutral brownish gray. In shaded areas, the normal color of weathered Monel is greenish brown, similar to, but less vivid than, treated copper. The general color effect is neutral.

Experiments have been made on Monel to produce a range of other permanent colors, but processes are not commercially practical as applied to roofing installations.



Monel sheet of standard roofing gauges is used for flashings, gutters, skylight caps and downspouts as well as for roof construction. Illustrated, left, Monel Roofing on Metropolitan Museum of Art, N. Y.; Above, left, roof of Tankers Trust Bldg., N. Y.; top-fitted with Monel. Above, right, Monel is used on all pitched roofs of the Pennsylvania Station, N. Y.

[ Reprinted through the courtesy of American Architect Time Saver Standards of Advertised Products ]

## SIZES AND

Monel Roofing is available in standard sizes and gauges. It is employed for recommended Standard .02 in weight and per square of

## APPLICATIONS

Monel Roofing is used for standing seam and gauges. It is employed for recommended Standard .02 in weight and per square of

## INSTALLATION

- No special
- The following
1. Bends are equal to twice
2. Use Monel nail through
3. Where
4. Monel sheet used on copper
5. Expansion

## COST

The cost of Monel Roofing is higher than that of other materials, but it is more durable and has a longer life span.

THE I  
67 Wall



# — Basic Data



## SIZES AND WEIGHTS

Monel Roofing sheet is furnished in a wide variety of sizes and gauges. Standard dimensions of sheets most commonly employed for roofing are 24" x 96", 30" x 96", 36" x 96". Gauges recommended for roofing work are No. 24 and No. 25 U. S. Standard, .025" and .021" respectively. These are comparable in weight and thickness with 20 oz. and 16 oz. copper. Weights per square of Monel Roofing are given in Table II.

## APPLICATION

Monel Roofing is adapted to installation with batten seam, standing seam or flat seam. Its use imposes no special structural requirements beyond those generally followed for any high grade sheet metal roofing. Roof decks may be of wood, cement, steel, gypsum or rigid insulation. They should be smooth and free from ridges or depression, clean and thoroughly dry before the roofing is applied. The customary layer of roofing felt should be installed under all Monel roofs. Limitations of pitch for the various types of roofing are standard, namely: 4" per foot minimum for batten roofings, 2" per foot minimum for standing seam, and about  $\frac{1}{4}$ " per foot for flat seam.

## INSTALLATION

No special technique is required for installing Monel Roofing. The following general rules should be observed:

1. Bends and seams should be made with a radius at least equal to twice the thickness of the sheet.
2. Use Monel clips, cleats and nails for attachment; do not nail through sheets.
3. Where soldering is necessary, joints between sheets should be locked and the solder thoroughly sweated into the joint.
4. Monel sheets are soldered by the same procedure as that used on copper; pre-tin edges of sheets with soft solder before soldering and use a killed acid flux with a small amount of ammonium chloride. High or low tin solders are equally effective.
5. Expansion joints and locked seams should be installed in accordance with standard roofing practice to allow for a free movement of .186" in a 10-foot length through a 200F temperature change. Otherwise the roofing may break at the seams under expansion and contraction of the sheets which are rigid and resist buckling.

## COST

The cost of Monel Roofing installed is greater than that of other commonly used metals. Comparative estimates for new work and records of replacement installations show that the cost of Monel Roofing installed, including contractor's labor, overhead and profit, will range from 12 $\frac{1}{4}$ % to 25% more than

Installation of Monel Roofing follows practice recognized as standard for other types of sheet metal roofing. Left, applying Monel Roofing with Monel clips and nails; center, soldering a gutter expansion joint; right, bolting a ventilator cowl. Monel Roofing can be installed with flat seams (Fig. A) standing seams (Fig. B) or batten seams (Fig. C)



TABLE II—Approx. Wt. per Square (100 sq. ft.)

Type of Roofing	Monel .021" (No. 25 U. S. S.)	Monel .025" (No. 24 U. S. S.)
Flat Seam	120 lb.	150 lb.
Standing Seam	115 lb.	140 lb.
Batten Seam	*125 lb.	*156 lb.
Wt. per Sq. Ft. Monel Sheets	1 lb.	1.56 lb.

\*—Varies with size of sheet used and spacing of battens.

for copper—labor being approximately the same in all cases. However, experience with Monel roofs has indicated that expense for maintenance is negligible. Costs of Monel Roofing figured over a period of years on a comparative basis should, therefore, be actually lower than those of less durable materials.

## TECHNICAL SERVICE

The International Nickel Company does not attempt to undertake the function of architect or contractor in roof design or in the installation of sheet metal roofing. Through its Technical Service Division, however, architects and contractors can freely obtain data on problems involving the use of Monel Metal, assistance in the solving of any unusual problems and any supplementary information regarding Monel products that may be desired.

## WHERE TO BUY

Monel Roofing is furnished and installed by roofing contractors throughout the country. Additional information and assistance in developing estimates will gladly be given by The International Nickel Company.

THE INTERNATIONAL NICKEL COMPANY, INC.  
67 Wall Street - - - - - New York, N. Y.

# 9 GOOD REASONS FOR USING MONEL

1. It resists the highly corrosive atmospheres of urban areas, containing fumes, smoke, and soot. Monel cannot rust.
2. Monel is strong—Monel's strength plus corrosion resistance provides a higher factor of safety than other metal roofing sheets.
3. This metal is rigid—its modulus of elasticity is 26,000,000 psi. This greater stiffness makes Monel highly acceptable for self-supporting portions of roofs, such as cornices and gutters.
4. Monel is harder and tougher than other commercial roofing materials. It resists wear from sliding snow, the scuffing of feet, and erosion by rain water.
5. This metal has a lower coefficient of thermal expansion and contraction than other high grade roofing metals, and therefore withstands the effect of temperature changes better.
6. Monel is highly resistant to fatigue under repeated flexing, thereby preventing "wiggle" cracks and weather cracking.
7. Monel roofs may be grounded to provide adequate protection against lightning.
8. Weathered Monel is neutral in color and does not detract from other architectural features.
9. Monel, while tough and hard, is readily fabricated—irregular roofing contours, decorative designs, skylight frames, ventilators, downspouts, gutters, and miscellaneous metal work present no difficulties when using Monel.

## WHERE MONEL ROOFS ARE USED

Monel roofs are well suited to monumental buildings—railroad stations, hospitals, schools, libraries, churches, museums, office buildings, etc. While higher in initial cost, its durability and freedom from maintenance expense makes its use most economical over a long period of years.

## MONEL ACCESSORIES

It is advisable to install Monel fittings and hardware on a Monel roof for an "all Monel" job. Monel nails, cleats, screws, bolts, etc., are readily available. Monel accessories are also useful for making repair jobs on roofs made of other materials. Write for Bulletin H-2, "Monel Metal Accessories."

## MONEL information may be obtained from the following sources:

**ATLANTA**  
J. M. Tull Metal & Supply Co., 285 Marietta Street

**BOSTON**  
Whitehead Metal Products Company, Inc.,  
235 Bridge Street, Cambridge, Mass.

**BUFFALO**  
Whitehead Metal Products Company, Inc.,  
254 Court Street

**CHICAGO**  
Steel Sales Corporation, 129 South Jefferson Street

**CINCINNATI**  
Williams and Company, Inc., 1921-1927 Dundas Street

**CLEVELAND**  
Williams and Company, Inc.,  
3700-3716 Perkins Avenue

**COLUMBUS**  
Williams and Company, Inc., 31 North Grant Avenue

**DALLAS**  
Metal Goods Corporation, Construction Building

**DENVER**  
Hendrie & Bolthoff Mfg. & Supply Co.,  
1621-39 Seventeenth Street

**DETROIT**  
Steel Sales Corporation, 4150 St. James Street

**HOUSTON**  
Metal Goods Corporation, 16 Drennan

**LOS ANGELES**  
Pacific Metals Co., Ltd., 1400 S. Alameda Street

**MILWAUKEE**  
Steel Sales Corporation, 647 W. Virginia Street

**MINNEAPOLIS**  
Steel Sales Corporation, 529 South 7th Street

**MONTREAL**  
Robert W. Bartram, Limited, 277 Duke Street

**NEWARK**  
Whitehead Metal Products Company, Inc.,  
205 Trelinghousen Avenue

**NEW ORLEANS**  
Metal Goods Corporation, 1401 Canal Bank Building

**NEW YORK**  
Whitehead Metal Products Company, Inc.,  
303 West 10th Street  
Bronx Office, 1334 Webster Avenue, Bronx

**PHILADELPHIA**  
Whitehead Metal Products Company, Inc.,  
721-729 Arch Street

**PITTSBURGH, N.S.**  
Williams and Company, Inc.,  
901-937 Pennsylvania Avenue

**ST. LOUIS**  
Steel Sales Corporation, 4565 McRee Avenue

**SAN FRANCISCO**  
Pacific Metals Co., Ltd., 3100-19th Street

**SEATTLE**  
Eagle Metals Co., 3628 East Marginal Way

**TORONTO**  
Perkover's Limited, 77 Front Street, E.

**VANCOUVER, B. C.**  
Wilkinson Company, Ltd., 190 Second Avenue, West